

## What is Claimed:

- 1                   1.     A method for analyzing an impurity in a gas, comprising  
2     the steps of:  
  
3                   introducing a first gas containing the impurity into at least a  
4     portion of a first cell;  
  
5                   introducing a second gas absent the impurity into at least a  
6     portion of a second cell;  
  
7                   emitting a light from a light source;  
  
8                   splitting the light from the light source into a first beam and a  
9     second beam;  
  
10                  directing the first beam of light through the first cell;  
  
11                  directing the second beam of light through the second cell;  
  
12                  measuring a decay rate of the first beam of light in the first cell;  
  
13                  measuring a decay rate of the second beam of light in the  
14     second cell; and  
  
15                  determining a concentration of the impurity in the gas based on  
16     a difference between the decay rates of the first and second cells.
- 1                   2.     The method according to claim 1, further comprising the  
2     step of maintaining substantially identical pressures within the first cell and  
3     the second cell.
- 1                   3.     The method according to claim 1, wherein the first beam  
2     of light and the second beam of light have an identical wavelength.

1                   4.     The method according to claim 1, further comprising the  
2     step of tuning the light source to a predetermined frequency.

1                   5.     The method according to claim 1, further comprising the  
2     step of analyzing the first gas and the second gas using cavity ring-down  
3     spectroscopy.

1                   6.     The method according to claim 5, wherein the first cell is  
2     filled with the first gas and the second cell is filled with the second gas.

1                   7.     The method according to claim 5, wherein the first gas  
2     flows through the first cell and the second gas flows through the second cell.

1                   8.     The method according to claim 5, wherein the first cell is  
2     filled with the first gas and the second gas flows through the second cell.

1                   9.     An apparatus for analyzing an impurity in a gas for use  
2     with a light source, comprising:

3                   a first cell at least partially containing a first gas with the  
4     impurity;

5                   a second cell at least partially containing a second gas absent  
6     the impurity;

7                   a splitter optically coupled to the light source to split the light  
8     from the light source into a first light beam and a second light beam, the first  
9     light beam coupled into an input of the first cell and the second light beam  
10    coupled into an input of the second cell;

11                  a first detector coupled to an output of the first cell and  
12    generating a first signal based on a decay rate of the first light beam within  
13    the first cell; and

14                   a second detector coupled to an output of the second cell and  
15     generating a second signal based on a second decay rate of the second light  
16     beam within the second cell,

17                   wherein a concentration of the impurity is determined based on  
18     a difference between the first decay rate and the second decay rate.

1                   10.    The apparatus according to claim 9, further comprising a  
2     processor coupled to the first detector and the second detector to receive  
3     and process the first signal and the second signal to determine the  
4     concentration of the impurity.

1                   11.    The apparatus according to claim 9, wherein the first light  
2     beam and the second light beam have an identical wavelength.

1                   12.    The apparatus according to claim 9, wherein the first  
2     detector measures the decay rate of the first light beam in the first cell.

1                   13.    The apparatus, according to claim 9, wherein the second  
2     detector measures the decay rate of the second light beam in the second cell.

1                   14.    The apparatus according to claim 9, wherein a pressure of  
2     the first gas in the first cell and a pressure of the second gas in the second  
3     cell are substantially identical.

1                   15.    The apparatus according to claim 9, wherein the gas  
2     comprises ammonia and the impurity comprises water.

1                   16.    The apparatus according to claim 9, wherein the light  
2     emitting source comprises a CW laser.

1                   17.    The apparatus according to claim 16, wherein the laser is  
2     tuneable.

1           18. The apparatus according to claim 9, wherein the first cell  
2 and the second cell each comprise a cavity ring-down spectroscopy cell.

1           19. The apparatus according to claim 18, wherein the  
2 concentration of the impurity is determined by comparing a ring-down rate at  
3 a peak of an absorption line of the impurity of the gas to a baseline ring-  
4 down rate absent the impurity.

1           20. The apparatus according to claim 18, wherein the  
2 concentration of the baseline ring-down rate is measured at an off-peak  
3 profile based on extrapolation to a peak wavelength.

1           21. The apparatus according to claim 18, wherein the  
2 concentration of the impurity is determined based on a measurement of a  
3 whole peak profile, which contains a strength and a lineshape formation, the  
4 concentration of the impurity being determined by fitting the lineshape.

1           22. The apparatus according to claim 18, wherein the first cell  
2 is filled with the first gas and the second cell is filled with the second gas.

1           23. The apparatus, according to claim 18, wherein the first  
2 gas flows through the first cell and the second gas flows through the second  
3 cell.

1           24. The apparatus, according to claim 18, wherein the first  
2 cell is filled with the first gas and the second gas flows through the second  
3 cell.

1           25. An apparatus for analyzing an impurity in a gas,  
2 comprising:

3                    means for introducing a first gas containing an impurity into a  
4 first cell and a gas absent impurity into a second cell;

5                    means for emitting a light into the first cell and the second cell;

6                    means for determining respective decay rates of the light in the  
7 first cell and the second cell; and

8                    means for determining a concentration of the impurity in the gas  
9 based on a difference between the respective decay rates in the first cell and  
10 the second cell.